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PATENT APPLICATION
Docket No.: 200206676-1

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND
INTERFERENCES

In re application of:

Inventor(s): Alfred I-Tsung Pan et al.
Serial No.: 10/629,742
Filed: July 30, 2003
Title: Stereolithographic Method for Forming Three-Dimensional Structure
Art Unit: 1791
Examiner: Tentoni, Leo B.
Confirmation No.: 8919

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APPEAL BRIEF

SIR OR MADAM:

This communication is the Appeal Brief in this application with respect to the attached Notice of Appeal and the Final Office action of January 8, 2008. This Appeal Brief is being filed under the provisions of 37 C.F.R. § 41.37. The filing fee for filing this Appeal Brief, as set forth in 37 C.F.R. § 41.20(b)(2), is included herewith as indicated on the attached Transmittal of Appeal Brief.

(Continued on next page.)

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1. Real Party In Interest:

The real party in interest is Hewlett-Packard Development Company, LP, a limited partnership established under the laws of the State of Texas and having a principal place of business at 20555 S.H. 249 Houston, TX 77070, U.S.A. (hereinafter "HPDC"). HPDC is a Texas limited partnership and is a wholly-owned affiliate of Hewlett-Packard Company, a Delaware Corporation, headquartered in Palo Alto, CA. The general or managing partner of HPDC is HPQ Holdings, LLC.

10 II. Related Appeals and Interferences:

There are no other appeals or interferences known to Appellants, the Appellants' legal representative, or assignee which will directly affect or be directly affected by or have bearing on the Board's decision in the pending appeal.

15 III. Status of the Claims:

The following list provides the status of all the claims in the application:

Claims 1-17: rejected – currently on appeal;

Claims 18-20: cancelled rejected;

Claims 21-25: rejected – currently on appeal;

Claims 26-30: cancelled; and

20 Claims 31-38: rejected – currently on appeal.

25 IV. Status of Amendments:

The Appellants believe that all previously submitted amendments have been entered.

30 V. Summary of Claimed Subject Matter:

The summary corresponds to independent claims 1 and 21, which are the independent claims on appeal. Discussions about elements and recitations can be found at least at the cited locations in the specification and drawings.

Claim 1:

With respect to claim 1, which is the first independent claim on appeal, a stereolithographic method of forming a three-dimensional structure (200, Fig. 1)

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includes the following steps:

a) Ejecting drops of first and second different liquefied materials in a pattern and allowing the drops to solidify to form a layer of a three-dimensional object (see ¶¶ [0005] and [0007], and Fig. 1). The second liquefied material is deposited to form portions of the layers which define an external surface of the three-dimensional object. (See ¶ [0013].)

b) The method further includes surrounding the layer with a viscous liquid (108, Fig. 1) and controlling the level of the viscous liquid to be essentially level with the uppermost level of the portion of the layer formed from the drops of liquefied material. (See ¶ [0012].)

c) The method next includes ejecting drops of the first and second liquefied materials in a pattern and allowing the drops to solidify and form another layer of the three-dimensional object. (See ¶¶ [0008] - [0009].)

d) The method then includes raising the level of the viscous liquid to a level proximate the uppermost level of the newly formed layer (see ¶ [0012]), and then repeating steps c) and d) (see ¶ [0010]).

Claim 21:

With respect to claim 21, which is the second independent claim on appeal, a method of forming a three-dimensional object (200, Fig. 1) includes ejecting drops of liquefied material into a vat (102) using an ejector (100). The method further includes scanning the ejector (100) in first and second mutually opposed directions to deposit and solidify said drops in a predetermined pattern to sequentially form layers of the three-dimensional object (200). (See also ¶ [0005] and ¶¶ [0007] - [0008]). The method also includes supplying a viscous liquid (110, Fig. 1) into the vat (102) to a level which is essentially level with the top of a most recently formed layer of the three-dimensional object (200), and thus the viscous liquid both supports the material being formed into a three-dimensional object (200) and fills in voids between drops of the material forming the three-dimensional object. (See also ¶¶ [0010] and [0016].) The method then includes removing the object (200) from the viscous liquid (110) in the vat (102) and then solidifying the viscous liquid remaining in the voids between solidified drops of the material forming the object. (See also ¶¶ [0021] - [0023]).

VI. Grounds of Rejection to be Reviewed on Appeal:

(A). Whether claims 1-3, 9-11, 14, 15 and 36 are unpatentable over U.S. Patent No. 6,838,035 to Ederer in view of U.S. Patent No. 6,939,489 to Moszner.

5 (B). Whether claims 4-8 are unpatentable over U.S. Patent No. 6,838,035 to Ederer in view of U.S. Patent No. 6,939,489 to Moszner and U.S. Patent No. 6,405,095 to Jang.

10 (C). Whether claims 12, 13, 16, 17 and 37 are unpatentable over U.S. Patent No. 6,838,035 to Ederer in view of U.S. Patent No. 6,939,489 to Moszner and U.S. Patent No. 5,510,066 to Fink.

15 (D). Whether claim 38 is unpatentable over U.S. Patent No. 6,838,035 to Ederer in view of U.S. Patent No. 6,939,489 to Moszner and U.S. Patent No. 6,579,479 to Edie.

15 (E). Whether claim 21 is unpatentable over U.S. Patent No. 6,838,035 to Ederer.

20 (F). Whether claims 22-24 are unpatentable over U.S. Patent No. 6,838,035 to Ederer in view of U.S. Patent No. 6,405,095 to Jang.

VII. Argument:

(A). Claims 1-17 and 36-38:

25 Each of claims 2-17 and 36-38 depend, ultimately, from claim 1. Claim 1 has been rejected as being unpatentable over Ederer in view of Moszner. The Appellants argue against the rejections of claim 1, and those claims depending therefrom, based on the following grounds:

(1) Not All Limitations of Claim 1 are Taught:

30 The Appellants respectfully disagree with the Examiner's contention that Ederer and Moszner, when combined, teach or suggest all the limitations of claim 1. Specifically, claim 1 requires the following limitation:

ejecting drops of first and second different liquefied materials in a pattern and allowing the drops to solidify to form a layer of a three-dimensional object, wherein the second liquefied material is deposited to form portions

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of the layers which define an external surface of the three-dimensional object.

However, contrary to the Examiner's assertion, Moszner does not teach the use of two different liquefied materials (i.e., a first material and a second material) to form the object. Rather, Moszner teaches the use of single material that may consist of two or more components such as a base material and a catalyst material.

A thorough search of Moszner reveals that Moszner never refers to the application of more than one material to form the object. Rather, throughout the specification, Moszner refers to application of "a material" and/or "a fluid" to form the object. For example, in the abstract Moszner states "[a] process...includes the step of applying a material." Moszner also states, "[t]he plot nozzle (14) is connected to a tube (20) which receives a fluid (22) from a container (24)." (Moszner Col. 6, lines 10-11.)

The Examiner cites col. 4, lines 5-7 of Moszner as evidence that Moszner teaches or suggests application of first and second different liquefied materials. However, Moszner does not actually teach application of first and second different materials. Rather, what Moszner teaches is application of a single material that can include two components. Specifically, at the aforementioned place cited by the Examiner, Moszner states, "...double cartridges are available in connection with two component materials."

Moszner goes on to provide examples of two component materials. For example, Moszner states, "[a] conventional dual hardenable film (Variolink II Base and Cat available from Ivoclar-Vivadent AG) was used ... [and] a mixing container was used which permitted the two components Variolink II Base and Variolink II Cat, to first be mixed in equal portions immediately before the nozzle outlet." (Moszner, col. 7, line 60 through col. 8, line 3.) Thus, at most, Moszner teaches only the use of a single material having two components. This is not equivalent to the Applicants' limitation requiring application of first and second different liquefied materials.

Hypothetically, even if the prior art did teach the use of a first and second different liquefied materials, as is required by the Applicants' claim 1, the prior art does not teach wherein the second liquefied material is deposited to form portions of the layers which define an external surface of the three-dimensional object, as is also required by claim 1.

Thus, the cited prior art references do not teach or suggest all the limitations of claim 1, as is required for obviousness.

(2) No Teaching, Suggestion or Motivation to Combine Ederer with Moszner:

5 Obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion or motivation to do so found either in the references themselves or in the knowledge generally available to one of ordinary skill in the art. (MPEP 2143.01.) The suggestion or motivation to combine the reference teachings must be based on some logical 10 reason apparent from positive, concrete evidence that justifies the combination. (*In re Laskowski*, 871 F.2d 115, 10 USPQ 2d 1397 (Fed. Cir. 1989).) The source of the suggestion can be: 1) expressly from the references themselves; 2) from knowledge of those skilled in the art that certain references or disclosures in the references are 15 known to be of special interest or importance in the particular field; or 3) from the nature of a problem to be solved, leading inventors to look to references relating to possible solutions to that problem. (*Micro Chem., Inc. v. Great Plains Chem. Co.*, 41 USPQ 2d 1238, 1244-45 (Fed. Cir.).)

20 The Appellants contend that the Examiner has not provided the requisite positive concrete evidence of a logical reason that justifies the combination of Ederer and Moszner.

25 In the first instance, in the Office action dated July 16, 2007, the Examiner concludes that it would have been obvious to one of ordinary skill in the art to combine the teachings of Ederer with those of Moszner in order to manufacture a three-dimensional product from various materials with a low investment cost. However, there 30 is no evidence to support the Examiner's conclusion. Specifically, there is no evidence that the combination of the teachings of Ederer and Moszner (or even that what was known to one of skill in the art at the time on the invention) would have been associated with an investment cost lower than the respective investment costs associated with each of the teachings of Ederer and Moszner individually.

Later, in the final Office action of January 8, 2008 (page 5), the Examiner only states, "one of ordinary skill in the art at the time the invention was made would have combined the known steps with no change in their respective functions, and the combination of the known steps would have yielded predictable results to one of

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ordinary skill in the art," and then cites to *KSR International Co. v. Teleflex Inc.*, 550 U.S. --, 82 USPQ2d 1385 (2007). However, *KSR* is not some "silver bullet", the mere citation to which substitutes for the "positive, concrete evidence that justifies the combination". In fact, the Appellants note that "rejections on obviousness grounds 5 cannot be sustained by mere conclusory statements; instead there must be some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness." (*In re Kahn*, 441 F.3d 977, 988 (CA Fed. 2006) cited with approval in *KSR*.) In this instance, the Examiner has merely made a conclusory statement without the requisite articulated reasoning with rational underpinning in support of the 10 obviousness rejections.

Thus, there is no teaching, suggestion or motivation in the prior art to combine the reference teachings to result in what is claimed, as is required.

Summary: Claim 1 is not obvious over Ederer in view of Moszner for at least the reasons set forth above. Since claims 2-17 and 36-38 depend, ultimately, from claim 1, 15 they are also non-obvious for at least the same reasons that claim 1 is not obvious.

(B). Claims 21-25 and 31-35: Each of claims 22-25 and 31-35 depend, ultimately, from claim 21. Claim 21 has been rejected as being unpatentable over Ederer. The Appellants argue against the rejections of claim 21, and those claims depending 20 therefrom, based on the following grounds:

(1) Not All Limitations of Claim 21 are Taught; Missing Limitations are not Obvious:

The Applicants note that claim 21 requires the following limitation:

removing the object from the viscous liquid in the vat and then solidifying the viscous liquid remaining in the voids between solidified drops of the material forming the object.

The Appellants agree with the Examiner's statement that Ederer does not teach solidifying any viscous liquid remaining in the voids. However, the Examiner does not provide any evidence that this limitation was known to those of ordinary skill in the art at the time the invention was made, as is required. Instead, the Examiner simply states 30 that this limitation would have been obvious to one of ordinary skill in the art at the time the invention was made because some of the liquid remains in the voids and this remaining liquid solidifies along with the rest of the three-dimensional object. However, there is no evidence showing that the remaining liquid would solidify rather than drain

away. Further, there is no evidence that it would have been more obvious to one of ordinary skill in the art to solidify the liquid remaining in the voids as opposed to allowing the liquid to drain away or otherwise be removed from the voids. As is pointed out above with respect to claim 1, there must be a logical reason apparent from positive, 5 concrete evidence that justifies the modification of the reference. The Examiner has not provided such requisite evidence.

Accordingly, the Applicants contend that the prior art does not teach or suggest all the limitations of claim 21, as is required, and further that it would have been obvious to modify Ederer to include the missing limitations.

10 **(2) Ederer Teaches Away From What is Claimed:**

Prior art that teaches away is evidence of nonobviousness. (MPEP 2145.) A prior art reference may be considered to teach away when a person of ordinary skill, upon reading the reference, would be led in a direction divergent from the path that the Applicants took. (*In re Gurley*, 27 F.3d at 553, 31 USPQ 2d at 1131 (Fed. Cir. 1994).)

15 Ederer states, "... the supporting fluid is ... selected to remain in its liquid state throughout the production process" (Ederer, col. 2, lines 54-58, and col. 3, lines 10-13.) It is apparent that this statement by Ederer teaches away from solidifying the viscous liquid, as required by claim 21.

20 Ederer also states, "Preferably, a glycerin solution is used as supporting liquid" (Ederer, col. 6, lines 33-34.) The Applicants contend that glycerin solution is not capable of being practically solidified as contemplated by the Examiner. (An 85% solution of glycerine (as described by Ederer) has a freezing point of 12.4°F). (See <http://www.dow.com/glycerine/resources/table8.htm>.) Thus, at room temperature (i.e., about 65°F or above), the glycerin solution of Ederer would be a liquid.) Therefore, it is 25 apparent that this statement by Ederer also teaches away from solidifying the viscous liquid, as required by claim 21.

30 Ederer additionally teaches that, "... dents in the surface of the layer produced during the last cycle are ... removed mechanically [by the leveling instrument]" (Ederer, col. 8, lines 1-5.) In other words, according to the teachings of Ederer, the surface of each top layer is smoothed, which prevents any voids from forming within the structure. Thus, according to this teaching of Ederer, solidifying the liquid remaining in the voids would be impossible because there are no voids formed in the structure. This

is still further evidence that Ederer teaches away from the limitations required by claim 21.

Accordingly because Ederer teaches away, there is strong evidence of the nonobviousness of claim 21.

5 Inasmuch as claims 22-25 and 31-35 depend from claim 21, it is therefore logical
that each of claims 22-25 and 31-35 are also not obvious over the cited prior art for at
least the reasons that claim 21 is not obvious, as set forth herein above.

Summary

10 The Appellants respectfully request that the Board overturn the final rejections of
each of claims 1-17, 21-25 and 31-38, and requests that those claims be allowed.

Dated this 3rd day of March, 2008.

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VIII. Claims Appendix:

Claim 1. A stereolithographic method of forming three-dimensional structure comprising:

5 a) ejecting drops of first and second different liquefied materials in a pattern and allowing the drops to solidify to form a layer of a three-dimensional object, wherein the second liquefied material is deposited to form portions of the layers which define an external surface of the three-dimensional object;

10 b) surrounding the layer with a viscous liquid and controlling the level of the viscous liquid to be essentially level with the uppermost level of the portion of the layer formed from the drops of liquefied material;

c) ejecting drops of the first and second liquefied materials in a pattern and allowing the drops to solidify and form another layer of the three-dimensional object;

15 d) raising the level of the viscous liquid to a level proximate the uppermost level of the newly formed layer; and

e) repeating steps c) and d).

Claim 2. A stereolithographic method as set forth in claim 1, wherein the first material comprises resin.

20

Claim 3. A stereolithographic method as set forth in claim 1, wherein the second material has a melting point which is different from the melting point of the first material.

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Claim 4. A stereolithographic method as set forth in claim 2, wherein the second material comprises metal.

Claim 5. A stereolithographic method as set forth in claim 1, wherein the second material and the first material comprise metal.

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Claim 6. A stereolithographic method as set forth in claim 1, further comprising the step of heating the three-dimensional object to a degree sufficient to soften the second material and induce it to flow into voids formed between solidified drops of the first

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material.

Claim 7. A stereolithographic method as set forth in claim 5, further comprising the step of heating the three-dimensional object to a degree sufficient to alloy the solidified drops of the first and second materials.

Claim 8. A stereolithographic method as set forth in claim 2, comprising:
using a thermoplastic resin as the first liquefied material; and
using metal as the second material.

10

Claim 9. A stereolithographic method as set forth in claim 2, comprising:
using a UV settable resin as the first material; and
irradiating the UV settable resin after deposition to cure the resin.

15

Claim 10. A stereolithographic method as set forth in claim 9, further comprising using a thermoplastic resin as the second material.

20

Claim 11. A stereolithographic method as set forth in claim 10, further comprising heating the thermoplastic resin so that it flows into the small voids between hardened drops of the UV settable resin.

Claim 12. A stereolithographic method as set forth in claim 8, further comprising using a copper as the second material.

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Claim 13. A stereolithographic method as set forth in claim 12, further comprising heating the metal so that it softens and flows into the small voids between hardened drops of the resin.

30

Claim 14. A stereolithographic method as set forth in claim 1, further comprising using a surface of the viscous liquid as a surface onto which drops of liquefied material can be ejected and using the viscous liquid to support portions of the three-dimensional structure during its formation.

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Claim 15. A stereolithographic method as set forth in claim 1, further comprising using the viscous liquid as an impregnation material which enters voids which are formed between solidified drops of the liquefied material.

5 Claim 16. A stereolithographic method as set forth in claim 15, wherein the step of using the viscous material as an impregnation material comprises removing excess viscous material from the three-dimensional structure.

10 Claim 17. A stereolithographic method as set forth in claim 15, wherein at least the viscous material which has entered the voids is hardened to increase smoothness of the external surface of the three-dimensional object.

Claims 18-20 (cancelled)..

15 Claim 21. A method of forming a three-dimensional object comprising:
ejecting drops of liquefied material into a vat using an ejector;
scanning the ejector in first and second mutually opposed directions to deposit and solidify said drops in a predetermined pattern to sequentially form layers of the three-dimensional object;

20 supplying a viscous liquid into the vat to a level which is essentially level with the top of a most recently formed layer of the three-dimensional object, wherein said viscous liquid both supports the material being formed into a three-dimensional object and fills in voids between drops of the material forming the three-dimensional object;
and

25 removing the object from the viscous liquid in the vat and then solidifying the viscous liquid remaining in the voids between solidified drops of the material forming the object.

30 Claim 22. A method as set forth in claim 21, wherein the step of ejecting comprises ejecting drops of first and second materials and controlling the drops of the second material to form a predetermined portion of the layer with respect to a portion of the layer which is formed of the drops of the first material.

Claim 23. A method as set forth in claim 22, further comprising heating the second material so that it flows into recesses defined by the solidified drops of the first material.

5 Claim 24. A method as set forth in claim 22, further comprising heat treating the first and second materials and forming an alloy of the same.

Claim 25. A method as set forth in claim 21, wherein the viscous liquid is highly viscous at room temperature and is not detrimentally reactive with the liquefied material.

10 Claims 26-30 (cancelled).

Claim 31. The method of claim 21, further comprising raising the level of the viscous liquid to a level of a last-formed layer of the three-dimensional object.

15 Claim 32. The method of claim 21, wherein said viscous liquid comprises a resin.

Claim 33. The method of claim 21, further comprising depositing drops of the liquefied material to form at least a portion of a layer of the object directly on a surface of the viscous liquid, the viscous liquid supporting that at least a portion of a layer without 20 other underlying support.

Claim 34. The method of claim 21, further comprising a sensor for sensing a level of the viscous liquid being poured into the vat, the sensor regulating a system for adding more viscous liquid to the vat.

25

Claim 35. The method of claim 21, wherein solidifying the viscous liquid remaining in the voids further comprises polymerizing the viscous liquid remaining in the voids.

30 Claim 36. The method of claim 1, wherein said viscous liquid comprises silicone oil, melted wax or molten metal.

Claim 37. The method of claim 16, wherein the impregnation material comprises a resin.

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Claim 38. The method of claim 1, wherein said first and second materials comprise silver and tin solder respectively.

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-- End of Claims Appendix --

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IX. Evidence Appendix:
None.

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X. Related Proceedings Appendix:
None.

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